REMARKS

I. Introduction

In response to the Office Action dated August 29, 2007, claims 1, 4 and 9 have been amended. Claims 1-14 remain in the application. Re-examination and re-consideration of the application is requested.

II. Prior Art Rejections

A. The Office Action Rejections

On pages 2-5 of the Office Action, claims 1-14 were rejected under 35 U.S.C. §102(b) as being anticipated by J. Yu et al., "Adaptive quantization for one-bit sigma-delta modulation," IEE Proceedings-G, Vol. 139, No. 1, February 1992, pages 39-44 (Yu).

Applicants' attorney respectfully traverses the rejections in view of the amendments above and the arguments below.

B. The Yu Reference

Yu describes adaptive quantization for one-bit sigma-delta modulation. A fixed step size usually is used for a quantizer in a sigma-delta modulator or noise shaper, but it cannot always match input signals adequately if they are nonstationary, as in the case of music. An attempt at introducing adaptive quantisers, based on a digital maximum-magnitude technique, into 1-bit sigma-delta modulators has been made, although the basic idea appeared about two decades ago. The initial results show it to be a promising technique. The dynamic range of the sigma-delta modulator can be effectively increased by using an adaptive quantiser, and the signal/noise ratio is nearly independent of input level for sine wave inputs. This advantage may increase future applications of sigma-delta modulators.

C. The Applicants' Invention is Patentable Over the Yu Reference

The Applicants' claimed invention is patentable over the Yu reference, because the claims contain limitations not taught by the Yu reference. Nonetheless, the Office Action asserts that Yu discloses all the elements of Applicants' claims.

Applicants' attorney disagrees. In Applicants' claimed invention, the step-size of the modulator is adapted based on an estimate of an absolute value of a signal output from a filter

before the signal is input to the quantizer. The Yu reference, on the other hand, describes different functions.

For example, Yu describes both forward and backward adaptation (wherein forward adaptation estimates the input to the quantizer while backward adaptation estimates the strength of input signal):

> Yu: Page 40, 2nd col., 3rd para.
>
> In order to adapt the step size, it is necessary to obtain an estimate of the time varying amplitude properties of the input signal. Usually, there are two types of method: forward and backward adaptation [12]. Forward adaptation is based on the estimation of unquantised samples, i.e. usually at the input of the quantiser. Backward adaptation is based on the estimation of the output of the quantiser. Fig. 3 shows their block diagrams. Forward estimates of step size are unaffected by quantisation noise, they are therefore more reliable. However, the system needs to transmit this additional information to the receiver. Although the backward estimates are not as accurate as the forward estimates, additional bits are not needed for the estimation.
>
> Yu: Page 40, 2nd col., 5th para.
>
> If a l-bit quantisation function is defined by
>
> $$q(n) = \begin{cases} d \text{ if } u(n) \geq 0 \\ -d \text{ otherwise} \end{cases}$$
>
> where $u(n)$ is the input of the quantiser [and $q(n)$ is the output of the quantiser], then the adaptive logic can be forward:
>
> $$d_i = c\sigma_u^2(i)$$
>
> or backward:
>
> $$d_i = c\sigma_q^2(i)$$
>
> where c is a scaling constant, and σ_u^2 and σ_q^2 are the variance of the signal $u(n)$ and $q(n)$, respectively. It is obvious that the backward logic is always constant, so it cannot be used for the one-bit case.
>
> Yu: Page 40, 2nd col., 6th para.
>
> A large amount of calculation is needed to obtain the short-time energy. An alternative approach is to use local values of peak output magnitude to vary the overload level. Thus for a forward adaptation of a l-bit quantiser, the logic can be in the form
>
> $$d_i = c|u|_{max}, \quad |u|_{max} = \max\{|u(i-k)|\}, \quad k = 1, 2, \ldots\ldots, K$$
>
> where d_i is the l-bit quantisation level of the ith data block and each block consists of K samples. Backward adaptation based on the maximum magnitude of the output of a l-bit quantiser is also meaningless because the maximum is always the same as the quantisation level. The maximum-magnitude logic is simpler than

the variance estimation and particularly appropriate to the control of overload distortion.

Nonetheless, Yu declined to use forward adaptation and instead used backward adaptation:

> Yu: Page 41, 1st col., 2nd para.
>
> Considering the case of sigma delta modulation, the additional bits to be stored or transmitted are unwanted, so backward adaptation has to be chosen.

The backward adaptation used in Yu is described by the following:

> Yu: Page 41, 1st col., 2nd para.
>
> An estimate of the maximum magnitude of the input is used for the adaptation.
>
> Yu: Page 41, 1st col., 3rd para.
>
> It is easy to estimate the magnitude of *x(n)* by lowpassing *q(n)* and then finding the maximum magnitude over a certain period of time. According to the maximum-magnitude logic, it is reasonable to have the adaptive logic as follows:
>
> $$d_{i+1} = cM_i \quad d_{\min} \le d_{i+1} \le d_{\max} \tag{6}$$
>
> where M_i is the maximum magnitude in the ith block the output samples of the lowpass filter, i.e., the maximum magnitude estimate of the input *x(n)* for the ith block, and d_{i+1} is the step-size for the $(i+1)$th block of samples.

See also, for example, FIG. 4 on page 41 of Yu, which shows the following:

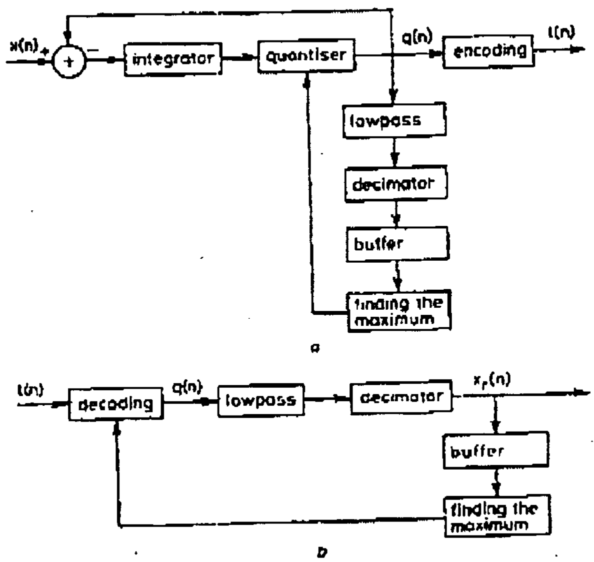

Fig. 4 *Adaptive SDM*
a Modulator
b Demodulator

Thus, in Yu, the output *q(n)* from the quantizer is used to alter or scale the step-size of the quantizer. Specifically, as shown in the "Modulator" of FIG. 4*a*, Yu processes the output signal *q(n)* of the quantizer through the "lowpass," "decimator" and "buffer," before "finding the maximum" is performed. In other words, Yu finds the maximum magnitude of the output *q(n)* from the quantizer and uses that value to adapt the step size of the quantizer.

Consequently, Applicants' claimed invention differs from Yu in that it generates a scaling signal using an estimation of the absolute value of the signal output from a filter before the signal is input to the quantizer, while Yu generates a scaling signal using a maximum magnitude of the signal output from the quantizer. These are two different functions performed by two different structures.

Moreover, the discussion of forward adaptation in Yu, which is explicitly rejected by Yu, is based only on estimates of the input to the quantizer, but not an estimation of the absolute value of the signal output from a filter before the signal is input to the quantizer. Indeed, nowhere does Yu refer to the use of a similar filter in the discussion of forward adaptation.

In view of these differences, it is respectfully asserted that the Yu reference does not anticipate or render obvious Applicants' claimed invention. Moreover, the various elements of

Applicants' claimed invention together provide operational advantages over the Yu reference. In addition, Applicants' invention solves problems not recognized by the Yu reference.

Thus, Applicants' attorney submits that independent claims 1 and 9 are allowable over the Yu reference. Further, dependent claims 2-8 and 10-14 are submitted to be allowable over the Yu reference in the same manner, because they are dependent on independent claims 1 and 9, respectively, and thus contain all the limitations of the independent claims. In addition, dependent claims 2-8 and 10-14 recite additional novel elements not shown by the Yu reference.

III. Conclusion

In view of the above, it is submitted that this application is now in good order for allowance and such allowance is respectfully solicited.

Should the Examiner believe minor matters still remain that can be resolved in a telephone interview, the Examiner is urged to call Applicants' undersigned attorney.

Respectfully submitted,

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